

## **HIGHLY EFFICIENT STEP-DOWN/STEP-UP AND STEP-UP/STEP-DOWN CHARGE PUMP**

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### **ABSTRACT**

A charge pumping system capable of a forward operation mode and a reverse operation mode is provided. In forward operation mode the charge pumping system can step-up an input voltage at a ratio of  $\frac{1}{2}:1$  and can step-down the input voltage at a ratio of at least one of 1:1, 3:2, 2:1 and 3:1. In reverse operation mode the charge pumping system can step-down the input voltage at a ratio of  $1:\frac{1}{2}$  and 1:1 and can step-up the input voltage at a ratio of at least one of 2:3, 1:2 and 1:3.